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THE BEHAVIOR OF ACTIVE AND INACTIVE RATS IN EXPERIMENTAL EXTINCTION AND DISCRIMINATION PROBLEMS[1, 2]

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I. Introduction

The overlap of traits and abilities is a problem which has received a great deal of attention in recent years. One way of attacking the problem is to start with two groups known to differ in one trait and to investigate their behavior in other situations. We have in the Minnesota laboratory two strains of rats which differ genetically in what is commonly called "spontaneous" activity. The present experiment is to determine if these strains differ in reactions under conditions of periodic reinforcement, experimental extinction, and discrimination.

II. Apparatus and Subjects

The apparatus used in this study is that described by Heron and Skinner (2). After the usual period of test-breaking all of the animals were run through the following routine:

1. Eight daily one-hour periods of reinforcement at the rate of one pellet of food every four minutes.
2. Seven daily one-hour periods of extinction, i.e., no pellets of food were given.
3. Seven periods of reinforcement identical to No. 1.
4. Fifteen days of discrimination, i.e., when the apparatus was set to give food a buzzer sounded which was turned off as soon as the rat received the food.

[1] Grateful acknowledgment is made to The National Youth Administration for help in the preparation of the results for this paper.
[2] Recommended for publication by Dr. J. R. Kantor, March 6, 1940.

The records taken are in terms of the number of times during each hour that the rat pressed the lever.

The animals used were 24 males from the F_{29} generation of the strain of active rats and 24 males from the F_4 generation of a strain of inactive rats which have been bred from a generation which were produced by cross-breeding the active and the original inactive strains. The inactive rats reproduce so poorly that it was necessary to make this cross-breeding in order to maintain the inactive strain. In the second generation after the crossing the rats are approximately at the same level of activity as their inactive great-grandparents.

Six of the active rats died and their data are not included. These rats were not apparently diseased. It is possible that the fact that the rats were confined during the experiment in small individual cages of 16 square inches floor space may have had a deleterious effect upon the active rats as extensive activity is practically impossible under these conditions.

The rats were approximately 240 days old at the start of the experiment.

The mean activity score for the active rats was 92,019 and for the inactive 37,618. The rats in neither group were from the extremes of their groups. These extremes were used for breeding purposes.

III. Results

The results for the two periods of reinforcement are shown in Table 1.

TABLE I

RESULTS FOR PERIODIC REINFORCEMENT

(A=active; I=inactive)

	Mean no. responses per rat per period	σm	D	σd	D/σd
A	81	8.1			
I	62	4.46	19	9.24	2.05
A	97	9.4			
I	59	5.45	38	10.9	3.48

It seems fair to interpret these data as indicating a significant difference in the rate of response between the two strains. The active rats respond at a higher rate than the inactive.

Because there is a progressive change in rate of response under experimental extinction it is not proper to summate the various periods. Therefore, in Table 2 are given the data for each experimental period.

The numbers in parentheses in Table 2 are the hypothetical records of the inactive animals equated for the difference in the levels in periodic reinforcement from which the two strains started. The correction factor is 1.13 based upon the first mean of periodic reinforcement.

Because of this difference in the periodic level it is difficult to interpret the data for extinction. The use of the correction fac-

TABLE 2

RESULTS FOR EXTINCTION

	Mean no. responses per rat	σm	D	σd	D/σd
A	58	8.0			
I	48 (54)	4.2	10	9.0	1.11
A	45	7.5			
I	35 (39)	4.0	10	8.4	1.19
A	39	4.7			
I	26 (29)	3.4	13	5.9	2.24
A	33	7.5			
I	23 (25)	3.4	10	8.2	1.22
A	40	6.5			
I	27 (30)	2.8	13	7.0	1.86
A	27	4.5			
I	19 (21)	3.0	8	5.3	1.49
A	22	4.0			
I	14 (15)	3.2	8	5.0	1.60

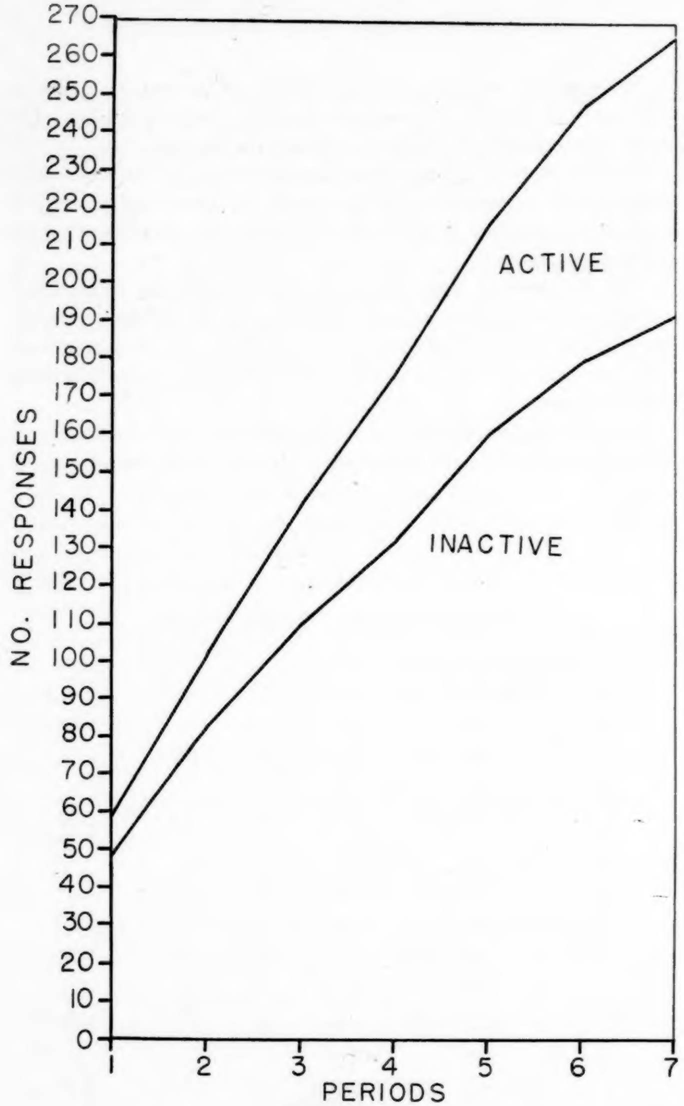

FIGURE 1

Cumulative curves of experimental extinction. The curves are not corrected for the difference in rate of response on periodic reinforcement.

tor is at best a questionable procedure. In no period is there a statistically significant difference in means, nevertheless the means for the inactives are consistently lower than for the actives and this is true even after the corrections are made. This consistency of trend leads one to state that there is probably a difference in the two strains in their reaction to the conditions leading to experimental extinction.

Figure 1 presents the data for extinction in a graphic form. The curves are cumulative curves of successive days records. The curve

TABLE 3
RESULTS FOR DISCRIMINATION

	Mean no. responses per rat	σm	D	σd	D/σd
A	95	11.0			
I	59 (96)	4.8	36	12.0	3.00
A	94	13.5			
I	58 (95)	5.4	36	14.5	2.48
A	88	11.7			
I	44 (72)	5.4	44	12.8	3.43
A	61	10.7			
I	30 (49)	4.4	31	11.5	2.69
A	70	9.0			
I	34 (55)	3.4	36	9.6	3.75
A	68	7.7			
I	36 (59)	3.8	32	8.6	3.72
A	74	9.2			
I	34 (55)	3.8	40	9.9	4.04
A	76	11.5			
I	35 (57)	4.6	41	12.3	3.33
A	85	11.7			
I	37 (60)	4.4	48	13.6	3.52
A	87	11.2			
I	35 (57)	4.6	52	12.1	4.29
A	83	11.5			
I	34 (55)	4.0	49	12.1	4.04
A	88	11.2			
I	28 (45)	3.2	60	11.6	5.17
A	86	11.2			
I	30 (49)	4.2	56	11.9	4.70
A	88	12.0			
I	30 (49)	4.4	58	12.7	4.56
A	82	10.7			
I	30 (49)	4.8	52	12.5	4.16

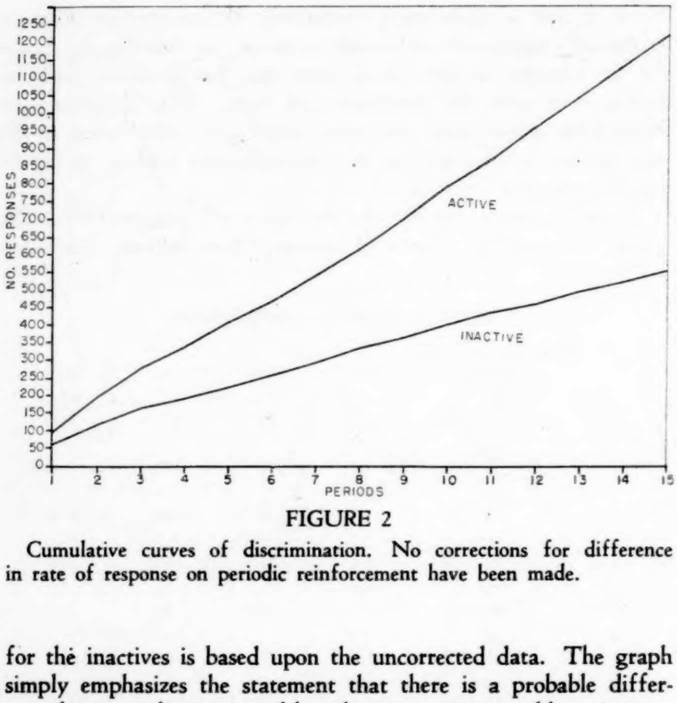

FIGURE 2

Cumulative curves of discrimination. No corrections for difference in rate of response on periodic reinforcement have been made.

for the inactives is based upon the uncorrected data. The graph simply emphasizes the statement that there is a probable difference between the strains although no two comparable points on the curves are different from the statistical point of view.

As the outline of the experiment indicates the animals were given seven days of periodic reinforcement after the period of extinction. They were then given an extended series of trials on discrimination. The moment the apparatus was set to give food a buzzer came on and stayed on until the food was received. Food was never given unless the buzzer was sounding. The animal could, therefore, learn that there is no use to push the lever unless the buzzer was sounding and his mean number of responses should decrease with successive practice periods.

Table 3 gives the results for the discrimination training.

There seems to be no question that the inactive rats learned to some extent the discrimination while the actives showed little if

any learning. The cumulative curves in Figure 2 demonstrate this conclusion graphically. As Table 3 shows, the comparable points on this graph are significantly different with two exceptions. A correction factor of 1.64 applied to the inactive data and based upon the second period of periodic reinforcement, of course, brings the data closer together but does not mask the learning of the inactive animals.

IV. Discussion

Inasmuch as both "spontaneous" activity and responses in the lever situation have been shown to reflect, among other factors, motivation (5) (6) it is not surprising that there should be a difference in the two strains under conditions of periodic reinforcement. It is possible that the active rats were more highly motivated in the present experiment. All rats were, of course, on a limited diet in terms of the time they were permitted to eat each day after removal from the experimental situation. They were allowed to eat one hour and twenty minutes. Since the active rats have a higher metabolic rate (3) it is reasonable to assume that they were hungrier each time they were put in the apparatus.

However, this explanation of the differential rate under periodic conditioning is not the only one possible. The active rats will show more "spontaneous" activity in the activity cages than the inactive animals even on an unlimited diet. Their energy conversion mechanism works at a greater speed probably owing to a greater thyroid functioning. This factor may work directly upon the rate of response in the lever situation rather than through the mediation of hunger.

Much the same alternative explanations may be given for the results of extinction. It has been shown that the rate of extinction will depend on the strength of drive (6) but in the present case the probable difference in the rate of extinction may be caused by other physiological conditions in the animals.

The results for discrimination are the most unexpected in this experiment. If we use the motivation explanation here we are led into the seemingly paradoxical statement that learning is hindered by a high drive. But as we have implied above there may be two

drives operating—especially in the active animals: the hunger drive and a drive to release energy in the form of activity. The active rat may press the lever not only to get food but also to expend energy. Rats given a dose of benzedrine sulphate will push the lever at a high rate even after several periods of experimental extinction and no reward of food (7). Energy could be released just as well by jumping up and down or any other type of activity but habit and food may serve to focus the behavior upon the lever. This point of view requires one to assume that it is more important to the active rat to release energy than it is to conserve it by waiting until the buzzer sounds to push. Some verification for this position could come from showing that the active rats in the case of experimental extinction do not simply decrease the rate of pressing the lever but also increase their activity in other parts of the experimental box. Unfortunately, no observations, in this connection, of their behavior have been made.

Of course, the immediate explanation which arises is that the active rats have a lower learning ability than the inactives. We have no direct answer to that explanation except to point out that the actives are better maze learners (4). It hardly seems likely, therefore, that the lack of learning by the active rats of the discrimination is indicative of the inability to learn.

V. Summary

1. Active and inactive rats differ in their rate of response to the lever pressing situation with periodic reinforcement. The active rats have a higher rate.

2. The evidence for a difference in the rate of experimental extinction is not so clear but the trend is for the inactive rats to maintain a lower level during the course of extinction.

3. There is a clear-cut difference in the action of the two strains to a discrimination situation. The active rats show practically no learning in this situation while the inactive rats show slow but appreciable learning.

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